U.S. Department of the Interior
Bureau of Land Management

Environmental Assessment
UT-020-2006-002
September 2011

Intrepid Potash Mine and Reclamation Plan (Modification)

43 CFR 3590 Mine Plan

Western Great Salt Lake Desert
Tooele County, UT

Applicant: **Intrepid Potash – Wendover, LLC**
2½ Mile East Frontage Road
Wendover, UT 84083

UTU-087809-087818

Salt Lake Field Office
2370 South 2300 West
Salt Lake City, UT 84119
Phone: (801) 977-4300
Fax: (801) 977-4397

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1.0 PURPOSE AND NEED

1.1 Introduction

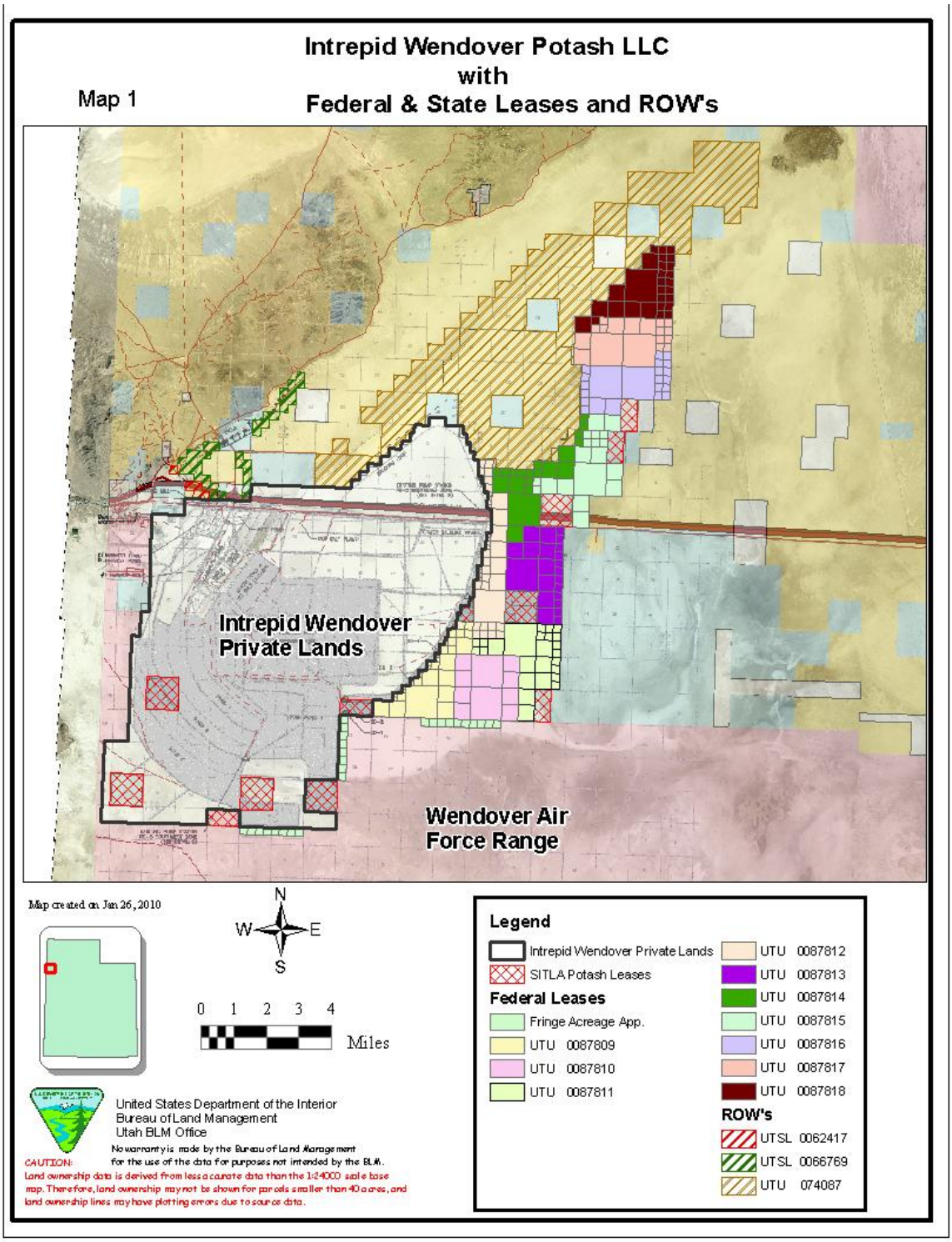
This Environmental Assessment (EA) has been prepared to disclose and analyze the environmental consequences of the Intrepid Potash Mine and Reclamation Plan Modification (Plan) as proposed by Intrepid Potash-Wendover, LLC (Intrepid). The EA is a site-specific analysis of potential impacts that could result with the implementation of a proposed action or alternatives to the proposed action. The EA assists the BLM in project planning and ensuring compliance with the National Environmental Policy Act (NEPA) and in making a determination as to whether any significant impacts could result from the analyzed actions. Significance is defined by NEPA and is found in regulation 40 CFR 1508.27. An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a statement of Finding of No Significant Impact (FONSI). If the decision maker determines that this project has significant impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a Decision Record may be signed for the EA approving the selected alternative, whether the proposed action or another alternative.

This EA refers to the Proposed Pony Express Resource Management Plan Final Environmental Impact Statement (RMP/FEIS) (September 1988). A FONSI statement documents the reasons why implementation of the selected alternative would not result in significant environmental impacts (effects) beyond those already disclosed in the RMP/EIS and addressed in the Record of Decision for the Pony Express Resource Management Plan and Rangeland Program Summary for Utah County (1990). This EA also incorporates by reference the analysis in the Environmental Impact Assessment of the Kaiser Aluminum & Chemical Corporation Proposed Pond System V, hereafter referred to as the 1975 EA (Whitney 1975).

1.2 Background

Potash extraction operations began in the early 1900's in Tooele County near Wendover Utah under the authority of the 1872 Mining Law. Although the Mineral Leasing Act of 1920 proclaimed that potassium and similar minerals such as sodium and magnesium were no longer locatable under the Mining Law, several thousand acres of mining claims were grandfathered and in 1929, patented into private ownership.

In 1936, Bonneville Ltd. was the first company to successfully produce potash by solar evaporation (Gywnn, p. 1-3, 1996). In April 1962 Bonneville Ltd. applied for ten potassium leases adjacent to their operations near Wendover Utah. Ten Federal Potassium (potash) leases covering 24,699.83 acres were issued to Bonneville Ltd. on January 1, 1963 under the authority of the Mineral Leasing Act of 1920. These ten leases were assigned to Standard Magnesium (and Chemical) Corporation on May 1, 1963. The leases were then assigned to Kaiser Aluminum and Chemical Corporation (Kaiser) on April 1, 1964. On July 1, 1988 the BLM approved the assignment of these leases to Reilly Tar and Chemical Corporation. On December 1, 2004 the leases were assigned to Intrepid Wendover Potash LLC (See Map 1).


Intrepid Wendover Potash LLC
with
Federal & State Leases and ROW's
Map 1
Intrepid Wendover
Private Lands
Wendover Air
Force Range
Map created on Jan 26, 2010
N
W
E
S
0 1 2 3 4
Miles
United States Department of the Interior
Bureau of Land Management
Utah BLM Office
No warranty is made by the Bureau of Land Management
for the use of the data for purposes not intended by the BLM.
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Land ownership data is derived from less accurate data than the 1:24000 scale base
map. Therefore, land ownership may not be shown for parcels smaller than 40 acres, and
land ownership lines may have plotting errors due to source data.
Legend
Intrepid Wendover Private Lands
SITLA Potash Leases
Federal Leases
Fringe Acreage App.
UTU 0087809
UTU 0087810
UTU 0087811
UTU 0087812
UTU 0087813
UTU 0087814
UTU 0087815
UTU 0087816
UTU 0087817
UTU 0087818
ROW's
UTSL 0062417
UTSL 0066769
UTU 074087

Mining Plan

In February 1963, Kaiser submitted a map to the United States Geological Survey (USGS[1]) showing the collection ditches on the north (of Highway 40[2]) Federal leases. On March 3, 1965, Kaiser requested permission from the USGS to start pumping water from the collection ditches north of Highway 40 into the potash mining operation. This (1965) map also showed ditches planned on the South leases on the section lines that run east and west (some of these ditches were never constructed). In 1975 the BLM approved an update to Kaiser's Mine Plan that allowed the company to move the primary evaporation pond 4 –PP4 from private property onto public leased land and create primary pond 5-PP5. In 2005 Intrepid purchased the mining operation. At that time BLM and the Utah Division of Oil, Gas and Mining requested Intrepid to submit a mining plan modification (Plan).

This final Plan was submitted in 2009. Modifications to this plan may be required as new data are acquired or as operational and/or plant processes are revised.

1.3 Purpose and Need for the Proposed Action

Intrepid has submitted the Plan with the intent of complying with the requirements specified in the Code of Federal Regulations (CFR) Title 43, Part 3590 *Solid Minerals (Other than Coal) Exploration and Mining Operations*. One of the provisions of this regulation requires the operator to extract the minerals on the lease to the fullest extent practical. In addition, Intrepid must comply with other regulations in 43 CFR 3500 which require the company to pay royalties on the portion of the final product that was extracted from Federal lands. The current plan was approved for the previous operator, Reilly Industries in 1998 and does not address the changes that have occurred in the operation since 1998, or the proposed changes that Intrepid is planning in order to keep up with current technologies and more efficient production. Also, the BLM needs an update of all aspects of Intrepid's operation including surety calculations and a reclamation plan.

1.4 Conformance with BLM Land Use Plan(s)

The 1990 Pony Express Resource Management Plan (RMP) provides direction for the management of mining related activities on BLM administered lands in Tooele County. The proposed action and alternative would conform to the general guidelines of the RMP, as amended, under Minerals Program Decision 4, page 28 of the Record of Decision. This Decision states: "Applications to remove other types of leasable minerals, such as

[1] The function for administering the MLA and the federal mineral leases was moved from the USGS to the Minerals Management Service (now called Office of Natural Resources Revenue) in 1982 and then in 1983 to the BLM.

[2] (Old) Highway 40 is located approximately 1/4 mile south of the present Interstate 80. At the present time this portion of highway 40 is not maintained.

phosphate, tar sands, and oil shale will continue to proceed on a case-by-case basis. Stipulations to protect important surface values will be required based on review of each proposal. Coal exploration and development, if any, would be regulated under 43 CFR 3400".

The Plan is also consistent with the following RMP decisions: Soil/Water/Air Decision 1 (evaluate), Decision 2 (protect water rights), Decision 4 (erosion), Decision 7 (air); Wildlife Decision 2 (T&E/SSP) & Decision 4 (protect habitat values); Recreation Decision 1 (manage as SRMA) & Decision 2 (OHV use); VRM Decision 1 (manage classes); Cultural Resources Decision 1 (evaluate); and Areas of critical Environmental concern (ACEC) Decision 1 (designation).

1.5 Relationship to Statutes, Regulations, or Other Plans

The following activity plans and documents also direct the Salt Lake Field Office's (SLFO) management in this EA: Solid Minerals Exploration and Mining Operations at 43 CFR § 3590, Recreation Area Management Plan Bonneville Salt Flats (USDI – BLM 1985), and Mine and Reclamation Plan (Shaw 2008).

The proposed action is consistent with Tooele County's General Plan (1995) to the maximum extent possible. Land use regulations under the jurisdiction of Tooele County and are published in the Tooele County Land Use Ordinance. The site is zoned multiple use with a minimum lot size of 40 acres (MU-40). Multiple use zoning districts are generally open and undeveloped land where human habitation would be generally limited. The land is encouraged to be used for mining among other activities such as recreation and grazing.

1.6 Identification of Issues

This project was posted on the Utah BLM Environmental Notification Bulletin Board (ENBB) and the SLFO public lobby on 9/30/2005. A BLM interdisciplinary team also reviewed the proposal; Appendix A contains the Interdisciplinary Analysis Record Checklist (ID Checklist). Based on internal and external input, the issues analyzed throughout this EA include:

Hydrology/Groundwater: Ground Water Hydrology: Increasing the amount of water pumped from the alluvial fan aquifer to accommodate the salt laydown project may be depleting the aquifer and increasing the flow from the shallow brine aquifer to the alluvial aquifer.

Area of Critical Environmental Concern (ACEC)/Cultural Values/Recreation: Removing mineral from the shallow brine aquifer north of I-80 may be causing the salt layer to thin and retract. Intrepid's voluntary continuation of the Salt laydown project may not be sufficient to prevent diminishment to the Bonneville Salt Flats (BSF) from drawing off the brine from adjacent areas. Such diminishment would degrade the unique

geology and historical relevance of the site and would disrupt the recreational opportunities that have been part of the BSF for over 80 years.

1.7 Issues not carried forward for detailed analysis

Socioeconomics: Comments received during scoping for the proposed action indicate concern that the salt flats might not continue to be suitable for recreational use, especially timed speed trial events. Additionally if the salt flats can't continue to support recreational uses, the surrounding communities might be negatively impacted economically. The BLM does not have any data to support this assertion since the salt flats seems to be remaining stable. Based on the analysis in Chapters 3 and 4 of this document, the salt-based surface should continue to serve recreational purposes and associated spending by recreationists within the planning area.

Approval or denial of the proposed action should not have an impact on employment at the Intrepid Wendover site or the unemployment rate in the impact area. The percent of employment by Intrepid constitutes less than .1% of the total employment in both Elko County, Nevada, and Tooele County, Utah, the two counties in which virtually all Intrepid employees reside.

Data Source: U.S. Department of Commerce. 2011. Census Bureau, County Business Patterns, Washington, D.C

2.0 DESCRIPTION OF ALTERNATIVES, INCLUDING PROPOSED ACTION

2.1 Alternative A: Proposed Action- Approve Plan as proposed

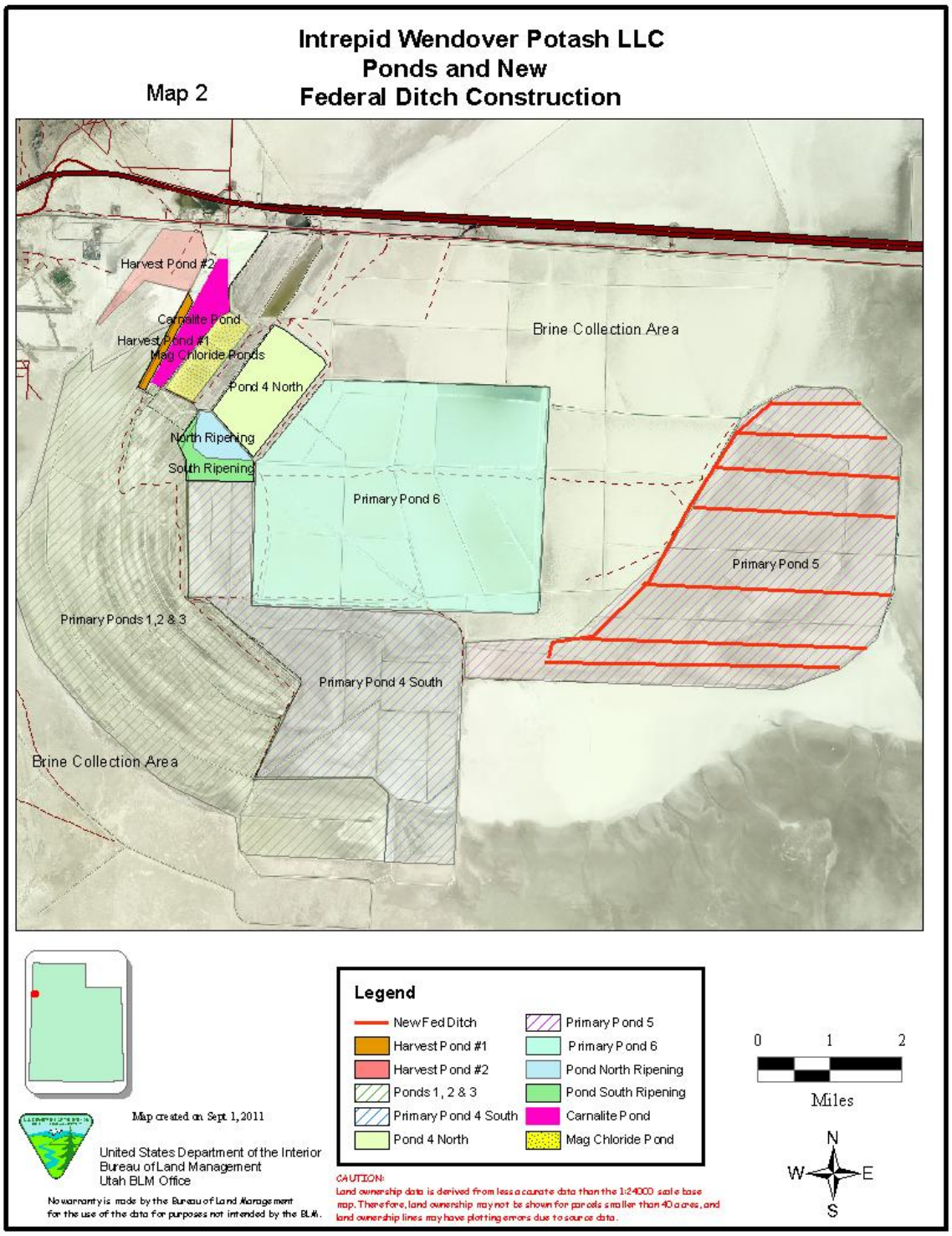
The BLM is responding to Intrepid's submission of an updated Plan and is required to approve the Plan (with conditions of approval as necessary). The specific new proposed actions in the Plan modification are to:

- Approve moving the primary evaporation pond back to private land using Primary Pond 6-PP6 and off Public Land which utilized PP5 (See Map 2).
    - In 2001 Intrepid Wendover moved their primary production pond from Federal leases PP5 to private lands PP6. This was necessary because the walls of the pond on the federal lease could not hold the brine due to the amount of salt that had been deposited on to the pond floor. The 1975 EA estimated that the PP5 life would be approximately 20 years.
- Approve a new ditch network on the South Federal leases.
    - Now that PP6 is the primary evaporation pond, Intrepid seeks to recover the brine that has leaked from the PP5 and place it into production. Intrepid would have to construct a new set of ditches to rehydrate the salt and move the brine into production.
- Approve Fringe Acreage lease application (UTU-85926) for 1,272 acres on the Wendover Bombing Range. The lease would be for administrative purposes only there would not be any surface disturbance in connection with the lease.
    - Regulations at 43 CFR 3594.5 state that there shall not be any collection ditches within 500 feet of the mine plan boundary unless approved by the authorized officer. There are several ditches that are currently within 500 feet of the boundary. Adding acreage through a fringe acreage lease would bring Intrepid into compliance with the regulation. There would be no surface disturbance allowed on these leases and the BLM would require a bonus payment for the leases prior to them being issued. The leases would be issued non-competitively if the bonus payment meets or exceeds the fair market value established by the BLM.
- Approve the Salt Laydown of sodium chloride onto the salt flats as part of the Plan.
    - In 1998 Reilly Tar and Chemical (predecessors to Intrepid Wendover) started an experimental salt laydown program to see if the salt crust thickness could be improved. Intrepid Wendover has continued this program and has included it on a voluntary basis into this plan to be approved under the mining plan.

    - Because of the voluntary basis of the salt laydown project in the proposed action, it attempts to achieve a mass balance of sodium chloride ions removed from the leases north of I-80. It also allows removal of the excess sodium chloride from the North and South Ripening ponds which increases the capacity of the ponds and allows Intrepid the ability to

continue processing potash without constructing new ponds. This salt is then pumped onto the salt flats. The Plan calls for a mass-balance (salt) to be calculated which would allow the BLM to show which lands the production is coming from. To accomplish this goal additional monitoring sites would be installed to determine the amount of salt being removed from the federal leases. They would monitor at the number 2 booster pump and three additional locations, one site to monitor the South Federal leases, one to monitor the private lands the third monitoring station is at the PP-6.

- Approve detailing the reclamation procedures and bonding requirements on Federal and non-Federal lands.
    - The Federal lease has always required reclamation. This plan details the reclamation on both federal and non-federal lands. The reclamation activities include the requirements for filling ditches, removing berms, facility removal, resurveying public lands, and plugging wells.
    - Consistent with section 2 of the Mining and Mineral Policy Act of 1970 and section 102(a), (8), and (12) of the Federal Land Policy and Management Act (FLPMA), it is the policy of the Department of the Interior to encourage the development of Federal mineral resources and reclamation of disturbed lands.


Intrepid Wendover Potash LLC
Ponds and New
Federal Ditch Construction
Map 2
Harvest Pond #2
Carnalite Pond
Harvest Pond #1
Mag Chloride Ponds
Pond 4 North
North Ripening
South Ripening
Brine Collection Area
Primary Pond 6
Primary Pond 5
Primary Ponds 1,2 & 3
Primary Pond 4 South
Brine Collection Area
Legend
New Fed Ditch
Harvest Pond #1
Harvest Pond #2
Ponds 1, 2 & 3
Primary Pond 4 South
Pond 4 North
Primary Pond 5
Primary Pond 6
Pond North Ripening
Pond South Ripening
Carnalite Pond
Mag Chloride Pond
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Miles
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Map created on Sept. 1, 2011
United States Department of the Interior
Bureau of Land Management
Utah BLM Office
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2.2 Alternative B- Proposed Action with Mitigation

This alternative is similar to the proposed action except the salt replenishment (salt laydown program) would be a mitigation requirement instead of a voluntary action. Intrepid would be required to return the same amount of salt (NaCl) to north of I-80 as was removed during mining based on a three year rolling sum. The goal of this salt laydown would be to replace the amount of sodium chloride that is removed from the Federal and State leases north of I-80 from the mining process and place it back onto the salt flats.

The mining plan (Intrepid, 2008, Dwg. 5.6) shows that Intrepid Wendover would install an ultrasonic flow meter with a data collection device at the number 2 booster pump collection point. This is the location where the brine exits the federal leases north of I-80. The meter would measure the total volume of brine and the plan calls for a sample port to analyze the chemical component of the brine, both pieces of data are required to calculate the total tonnage of all salts. A similar meter would measure volume and the chemical composition of the brine returned to the salt flats. Intrepid would report to the BLM on an annual basis the salt tonnages removed from north of I-80 and deposited on the BSF.

The evaluation period would be on a three calendar year basis and would use the following calculation where SL= Salt Laydown, SH= Salt Harvested from the leases north of I-80 and the three years are Y1, Y2 and Y3:

$$(Y1SL + Y2SL + Y3SL) / (Y1SH + Y2SH + Y3SH) = 1.0 \text{ or greater}$$

Monitoring and Adaptive Management

By the end of 2018, Intrepid will repeat the BLM's 2003 salt-crust thickness study on the BSF. If data indicates that the salt volume is decreasing, terms and conditions would be devised to add to the Federal leases when they are renewed in 2023.

2.3 Alternative C – No Action

Under this alternative, the Plan would not be approved. Intrepid would continue to operate under the 1975 Plan.

2.4 Alternatives Considered, but Eliminated from Further Analysis

Another alternative considered was to, during the winter months, flood PP6 with brackish water, and pump the resulting brine to the BSF. This alternative was eliminated because Intrepid had tried this method and found that it resulted in a substantial economic loss. When brine from the borrow ditch (see Section 4.4.2 of Intrepid's mine Plan) mixed with the brine created by dissolving the deposited salt the resulting mixture was high enough

in potash, that to have deposited it on the BSF without first harvesting the potash would have resulted in the loss of several million dollars.

3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter presents the potentially affected existing environment (i.e., the physical, biological, social, and economic values and resources) of the impact area as identified in the Interdisciplinary Team Checklist found in Appendix A and presented in Chapter 1 of this assessment. This chapter provides the baseline for comparison of impacts or consequences described in Chapter 4. Information from the Plan is incorporated by reference as required. Disclosure is subject to proprietary and confidentiality requirements.

3.2 General Setting

The analysis area is located in the westernmost part of Tooele County, Utah on the Bonneville Salt Flats (BSF) as illustrated in Map 1. The BSF is located in the western part of the Great Salt Lake Desert in northwest Utah. The Great Salt Lake Desert extends east of the potash mine for 46 miles to the Cedar Mountains, south for approximately 65 miles and north for 60 miles. The plant facilities and offices are located approximately 3 miles east of Wendover, Utah on old U.S. Highway 40. The site is located approximately 3 miles east of the Nevada border and is primarily located south of Interstate Highway 80 (I-80) although portions of the site are located north of I-80.

Geologic Setting

The Bonneville Salt Flats are located in western Utah within the Great Salt Lake Desert subdivision of the Basin and Range physiographic province. The province extends 500 miles from the east flank of the Sierra Nevada Mountain, California to the west flank of the Wasatch Mountains, Utah. The Basin and Range Province is defined by north-south trending mountains that alternate with intervening basins and occurred as a result of tectonic extension of the crust. The basins are commonly filled with lake sediments and erosional material from the surrounding mountains. This sequence of mountain-range building and basin formation started between 17 and 23 million years ago and has continued to the present time in some areas (Lines, 1979, p. 23). The Silver Island Mountains are the first mountain range west of the Bonneville Salt Flats and form the highest topographic feature in the area (Ford, 1988).

Potash Production

The water in the Wendover area contains a high volume of salt including sodium chloride or table salt (NaCl) potassium chloride (KCl) or potash and magnesium chloride ($MgCl_2$). This salt laden water is referred to as brine, which is contained interstitially in the surface and subsurface mud layers of this basin as ground water and referred generally as the shallow brine aquifer.

To harvest the salts in the brine from the shallow brine aquifer, ditches are dug below the water table which allows the brine to collect into a ditch system. Some brine is collected from the basin fill aquifer which is deeper and is pumped into the collection ditches. The ditches transport the brine to a series of ponds that use solar evaporation to reduce the amount of water in the solution. As the water decreases in volume by evaporation, the major salts in the solution reach saturation and precipitate out of solution, sodium chloride (NaCl) is the first salt to precipitate out in ripening pond 6 (PP6). The brine is then moved to a second series of ponds where the brine is allowed to sit to allow for additional evaporation. The brine is again moved and eventually the second salt, potassium chloride becomes saturated and falls out of solution in the harvest ponds. At this point the potassium chloride still has some sodium chloride associated with it and is called sylvinite. Once the sylvinite dries, it is sent to a mill for further processing to remove the sodium chloride which leaves the potassium chloride for shipment to market. The remaining brine contains some potassium and magnesium and it is moved to the carnalite ($KMgCl_3.6H_2O$) pond where carnalite is precipitated out of solution. This pond is flooded periodically and the brine is returned to recover the potassium. Magnesium chloride is the only salt to remain in solution because it is hydroscopic and cannot be turned into a solid form without industrial processing; therefore it is left in solution and sold in liquid form.

Salt Crust and Salt Laydown

The salt crust surface area and volume from the Bonneville Salt Flats (BSF) has been a concern to racing enthusiasts since the early 1960's. The potash extraction operation has been identified by the public and the land management agencies as a potential cause of perceived salt crust depletion. While there is a perceived depletion, the study by White and Terrazas (2006, p.1) concluded there was no difference between the 1998 and 2003 measurements. Sodium chloride on the salt flats is dissolved by rain and due to a lack of evaporation in the cooler months it mixes with the Shallow Brine aquifer and forms a pond on the surface of the salt crust. White and Terraza (2006, p. 26) continued that, as the brine is removed from collection ditches, the amount of sodium chloride north of the interstate in the Shallow Brine aquifer is decreased by a certain amount. The sodium chloride balance in the Shallow Brine aquifer is most likely maintained by dissolution of the salt crust. If not maintained in a mass balance this reduction due to extraction of sodium chloride in the brine would most likely start to eventually deplete the salt crust volume.

From 1998 through 2003, Reilly Industries participated in an effort to supplement the natural deposition of salt minerals to the BSF north of I-80. Approximately 1.5 million tons per year of salt were targeted to be re-saturated from former Pond 4 North and a high concentrated salt solution was pumped onto the salt crust/flat surface north of the mining facility for the 5-year test period. During the 5-year program, approximately 6.2 million tons of salt were deposited north of I-80. Intrepid has continued to pump brine north of I-80 from 2003 to the present.

The ecology of the salt crust is not well understood, given the amount of salt put back onto the salt flats, an increase in the salt crust thickness would have been expected; however the salt crust did not respond as anticipated. To date all studies conducted have not been successful at describing the relationship between the salt removed and replaced on the salt flats. Nor is there an explanation as to the ultimate fate of the relocated salt. Factors such as geochemical interactions, climatic conditions, road construction, increased recreation or other factors could have a significant role in the ecology of the salt flats and have not been studied yet.

At the present time Intrepid Wendover is utilizing the salt from the North and South Ripening ponds in order to provide salt for the salt laydown project, most all of the salt in Pond 4 North has been removed. Intrepid is in the process of placing Pond 4 North as part of Primary Pond 6. This pond would then become part of the salt laydown and would be utilized to help supplement the amount of salt that would be available in the future for the salt laydown aspect of the plan.

The salt laydown project is beneficial to Intrepid's operation. Sodium Chloride is a byproduct of potash production. Prior to the salt laydown project the salt accumulated in the ripening ponds, the laydown project allows Intrepid to rehydrate the byproduct and return it to the salt flats, thereby increasing the life of the ripening ponds.

3.3 Resources/Issues Brought Forward for Analysis

3.3.1 Resource 1: Ground Water Hydrology

Depositional Environment

The Great Salt Lake Desert is dominated by extensive playas and mud flats composed of Pleistocene and Holocene lake sediments. The playa and lake sediments consist mainly of salt crust, clay strata with interbedded fine-grained gypsum-crystal strata, organic material and thin-bedded oolitic-sand strata. The oolitic sand is made up of calcite-coated brine shrimp fecal pellets and sand-sized ovoids composed of concentric layers of calcite or aragonite minerals. The salt crust and surrounding playa of the Bonneville Salt Flats were formed by the precipitation of bedded halite (NaCl) and gypsum ($CaSO_4 \bullet 2H_2O$) minerals (Lines, 1979; Turk et al, 1973). These sediments contained brackish to saline ground water and are the remnants of Pleistocene fresh-water Lake Bonneville and its subsequent multiple evaporation episodes (Nolan, 1927). Lake Bonneville occupied the western half of Utah from 32,000 to 14,000 years before present and covered an estimated 20,000 square miles. The basin fill that underlies the Bonneville Salt Flats is about 5,000 feet deep (Lines, 1979, p. 27). Drillers logs from test wells have enabled geologists to describe the layers of the basin to a depth of about 3,000 feet below the surface. These deposits are mainly composed of clay and gypsum with some conglomerate (Bingham, 1980, p.231).

Hydrogeology

The Bonneville Salt Flats is included within a playa that occupies the topographic low in the Great Salt Lake Desert and consequently is the lowest point and discharge site for regional ground-water flow. Three aquifers affect the Bonneville Salt Flats:

1. A Shallow- Brine (Upper) aquifer (defined by Lines, 1979, p. 65, and Turk, 1973, p. 8, Mason and Kipp, 1998, p.1) occupies pore spaces in the upper 15-25 feet of surface which are remnants of Lake Bonneville sediments and is the primary source of the minerals being processed at Intrepid Potash Wendover LLC (Mason and Kipp, 1998, p. 22). Brine concentrations range from 65,000 to 325,000 mg/L total dissolved solids (TDS) (Mason and Kipp, 1998, p. 45). Because the salt crust occupies the lowest point in the playa, it is both bathed by the shallow-brine aquifer and serves (along with the surrounding playa) as its point of natural discharge. Rather than being a single massive layer of salt, the salt crust is actually composed of three (3) halite (table salt) and two (2) gypsum strata (White and Terrazas, 2006, p. 3).
2. A Basin-Fill (Deep Brine) aquifer (defined by Lines, 1979, p. 57) ranges from 20 to 30 feet below the ground surface to 840 feet deep contained within a thick conglomerate unit which overlies Tertiary-age volcanic rocks. Although the Deep Brine aquifer chemistry is similar (percentages) to the Shallow-Brine aquifer, the TDS concentrations are considerably lower by a factor of 2.5 times.
3. An Alluvial- Fan aquifer is contained along the south-eastern flank of the Silver Island Mountains. Sediments hosting the aquifer include sand and gravel that gradually become mixed with silt and clay-sized particles as the fans extend into the surficial lake sediments (Mason and Kipp, 1998, p. 39). This aquifer contains fresher water as opposed to the other two aquifers but the water is considered to be brackish and ranges from 6,200 to 8,000+ mg/L TDS (Mason and Kipp, 1998, p. 49).

See Appendix B for more detailed information on the properties and chemistry of the three aquifers.

3.3.2 Resource 2: ACEC/Recreation/Cultural Values

Management of the land encompassing the BSF has a complex history involving a variety of state and federal agencies and private organizations. Management has involved a variety of resource activities including potash leases, patent issuance, military uses, and recreational activities involving racing and filming.

In 1985, the portion of the BSF north of I-80 was designated as an ACEC. As per the RMP, management objectives include: (a) preserve the unique visual, historic and geological resources, (b) minimize and manage mineral uses and other surface disturbing activities to avoid resource damage, (c) coordinate management of the BSF ACEC and (d) recognize and manage racing and filming activities on the salt flats. As such, three

criteria were established to preserve the BSF due to their importance for national and international communities. The criteria include land speed racing, unique vistas and a unique geographic area.

Approximately 5,350 acres of the Intrepid leases are located within the ACEC, along with approximately four miles of brine collection ditches. The majority of Intrepid's operation, including all the ponds and processing facilities is located south of I-80. The Salduro Loop, an abandoned brine collection ditch that runs along the edge of private land north of I-80, the western edge of the loop which parallels the southern section of the straight track, is north of I-80, but the ditch was abandoned in April 1966. With the abandonment of the Salduro Loop, the only brine drainage ditches within two miles of the straight course or the old oval course are aforementioned four miles of brine ditches within the ACEC.

At the same time the ACEC was established, it was also designated a Special Recreation Management Area (SRMA). Recreational events include Rocket Launches, Speed Timing Events, Flight Events and a half marathon. Since 2000, $224,436.31 in Special Recreation Permit Fees have been collected by the BLM for events held at the site. Fees for other uses, such as filming, are also collected by the BLM.

During the winter and spring months each year, recharge into the shallow brine aquifer causes the water table to rise above ground level at the Bonneville Salt Flats. Precipitation mixes with the brine, decreasing the concentration and dissolving part of the salt crust. As the temperatures rise in late spring and early summer, the standing water evaporates, re-precipitating the salt back onto the crust and the water table lowers, allowing the crust to solidify. Speed events are normally held in late summer after the crust has hardened.

The BLM, the potash mining company (Reilly Industries), and the racing community (represented by Save the Salt [STS]) developed a project to mitigate the perceived depletion of the salt crust through a cooperative Salt Laydown Project (White, 2002, p. 435; White, 2004, p. 243). Sometime during the non production months, the mining company rehydrates the ripening ponds containing the sodium chloride and pumps the salt laden water back onto the salt flats. The Salt Laydown Project began its delivery of salt water to the Salt Flats in November 1997 and is currently continued on a voluntary basis by Intrepid Potash, Wendover (Reilly's successor).

The Bonneville Salt Flats Race Track was also listed in the National Registry of Historic Places in 1975.

4.0 ENVIRONMENTAL IMPACTS

4.1 Introduction

This section will discuss the impacts on the environment as they relate to the alternatives and the actions in the Plan.

4.2 General Analysis Assumptions and Guidelines

Analysis assumptions:

1. Mining will continue as provided in the mining plan.
2. Current climatic and hydrological relationships would remain the same.

4.3 Direct and Indirect Impacts

Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. See the following Table 4.3.0 for a summary of impacts of this action.

Table 4.3.0 Resource Impact Table Summary

	Primary Pond Relocation	***New Ditch Locations***	***Fringe Acreage Lease***	***Salt Lay Down***	***Reclamation***
Resource: Hydrology **Alt. A Proposed Action**					
Shallow Brine aquifer	Positive Impact	Positive and Negative Impact	No New Impact	Potential Negative Impact	Positive Impact
Basin Fill aquifer	No New Impact	No New Impact	No New Impact	Positive Impact	Positive Impact
Alluvial Fill aquifer	No New Impact	No New Impact	No New Impact	Negative Impact	Positive Impact
Alt. B Proposed Action with Mitigation					
Shallow Brine aquifer	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Positive Impact	Same As Proposed Action
Basin Fill aquifer	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same as proposed Action	Same As Proposed Action
Alluvial Fill aquifer	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Negative Impact	Same as Proposed Action
Alt. C No Action					
Shallow Brine aquifer	Same As Proposed Action	Positive and Negative Impacts Lessee	Negative Impacts Lessee	Potential Negative Impact	Negative Impact
Basin Fill aquifer	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Negative Impact
Alluvial aquifer	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Negative Impact

	Primary Pond Relocation	***New Ditch Locations***	***Fringe Acreage Lease***	***Salt Lay Down***	***Reclamation***
Resource: ACEC/Recreation					
Alt. A Proposed Action	No New Impact	No New Impact	No New Impact	Potential Negative Impact	Positive Impact
Alt. B Proposed Action with Mitigation	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	No Impact	Same As Proposed Action
Alt. C No Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action	Same As Proposed Action

4.3.1 Resource 1: Ground Water Hydrology

4.3.1.1 Alternative A Proposed Action

Shallow Brine aquifer

Primary Pond Relocation: Moving the pond from the federal leases back to private leases would have a positive impact on the aquifers, sodium chloride left in pond 5 would be allowed to be reclaimed and returned to the shallow brine aquifer and therefore potentially recharging the salt flats. The PP6 would have leakage and that would recharge that portion of the Shallow Brine aquifer.

New ditch location on South Leases: The impact on the shallow brine aquifer is the mineral resource would be extracted until it becomes unprofitable to do so. The new ditch configuration allows for the ability for production accounting on the south leases.

Fringe Acreage Lease: The fringe acreage lease would have no further impacts than it currently has because there would be no surface disturbance allowed.

Salt Laydown: The water component of the shallow brine aquifer is thought to be recharged from direct precipitation and the minerals recharged from relatively slower processes, as brine is drawn off by potash extraction operation, the mineral concentration of the aquifer is slowly decreasing by the amount of production each year. Therefore by supplementing the mineral recharge only "as site conditions dictate (Intrepid, 2008, p. 94) the proposed action could eventually reduce the concentration of minerals in the shallow brine aquifer north of I-80. This could result in the leaching of more salt from the salt crust into the aquifer and reducing the size and thickness of the crust.

Reclamation: Reclamation would stop brine and mineral production in the reclaimed area thus returning the aquifer or portion of the aquifer back to its original condition. It is unknown whether or not the aquifer would be affected by the fill material that is placed into the ditches.

Basin Fill aquifer

Primary Pond Relocation: There would be no new impact on the Basin Fill aquifer because the relocation action is a surface disturbance issue and not a Basin Fill aquifer issue.

New ditch location on South Leases: There would be no new impact on the Basin Fill aquifer because the ditches do not intercept the Basin Fill aquifer.

Fringe Acreage Lease: There would be no new impact by issuing these leases. There will be no wells drilled into the Basin Fill aquifer from these leases.

Salt Laydown: The Basin Fill aquifer may contribute some of the salt that is necessary to run the salt laydown project but the amount of brine removed from this aquifer is very small and the impact on the aquifer is unknown.

Reclamation: The well(s) that are drilled into the Basin Fill aquifer would be plugged and abandoned and the pump removed, thus returning this aquifer back to a natural condition.

Alluvial Fan aquifer

Primary Pond Relocation: This would have no new impact on the Alluvial Fan aquifer because this pond is for production purposes.

New ditch location on South Leases: This would have no new impact on the aquifer.

Fringe Acreage Lease: This would have no new impact on the Alluvial Fan aquifer.

Salt Laydown: The Alluvial Fan aquifer would continue to be pumped at the rate of approximately 1.2 billion gallons per year (Intrepid, 2008, p.72) the permit issued by the Utah Division of Water Rights allows Intrepid to pump 8.6 billion gallons per year. Based upon earliest data (Turk, 1969, p.77) and the information submitted by Intrepid Wendover in the mining plan in 2008, indicates there has been an increase in salinity in the Alluvial Fill aquifer from 8,200 ppm TDS to over 18,000 ppm (Intrepid, 2008,p. 8). Individual wells have not been tracked but, these figures are based on the average of all the wells. The effect of this pumping shows the Alluvial Fan aquifer is interconnected with the Shallow Brine aquifer and the pumping of the Alluvial Fan aquifer is drawing some of the brine from the Shallow Brine aquifer. As the Alluvial Fan aquifer becomes more saline, the company would have an increasingly difficult time using this water for the intended purpose. Even at the original values reported by Turk, (8,200 – 18,000 ppm) the aquifer is unfit for human consumption. The EPA (2010) has non mandatory secondary drinking water standards of 500 mg/L (parts per million) for human consumption and 3,000 ppm for livestock.

Based on this information there appears to be an environmental impact on the Alluvial Fan aquifer but there is no human (wildlife, livestock, and plant) use for this brackish water so there is no effect on the human environment. Once pumping stops then the direction of flow from the aquifer would be returned toward the center of the basin and the aquifer may recover to some degree. There are no plans to change the system.

Reclamation: The wells that are drilled into the Alluvial Fan aquifer would be plugged and abandoned and the pumps removed. This would return the aquifer back to its original hydrological condition and would reverse the apparent flow from the Shallow Brine aquifer.

4.3.1.2 Alternative B-Proposed Action with Mitigation

Shallow Brine aquifer

Primary Pond Relocation: The impacts would be the same as described in the Proposed Action.

New ditch location on South Leases: The impacts would be the same as described in the Proposed Action.

Fringe Acreage Lease: The impacts would be the same as described in the Proposed Action.

Salt Laydown: This would ensure that the mass-ion balance would be maintained for the salt flats and there should be no depletion of salt. If the lessee does not comply with the mitigation, 43 CFR 3598.4 requires that a notice of non-compliance (NNC) be written. The NNC must state the reason for issuance and specify the action to take in order to comply with the notice. Depending upon the amount of material that is deficient and the fact that the laydown is only run during the winter months, it may take as long as two years for the company to come back into compliance. If the company encounters problems such as Acts of God, there may be reasons to allow the company to put less salt back than is taken off.

Reclamation: The impacts would be the same as described in the Proposed Action.

Basin Fill aquifer

Primary Pond Relocation: The impacts would be the same as described in the Proposed Action

New ditch location on South Leases: The impacts would be the same as described in the Proposed Action

Fringe Acreage Lease: The impacts would be the same as described in the Proposed Action

Salt Laydown: The impacts would be the same as described in the Proposed Action

Reclamation: The impacts would be the same as described in the Proposed Action

Alluvial Fan aquifer

Primary Pond Relocation: The impacts would be the same as described in the Proposed Action

New ditch location on South Leases: The impacts would be the same as described in the Proposed Action.

Fringe Acreage Lease: The impacts would be the same as the Proposed Action

Salt Laydown: There would be an impact on the Alluvial Fan aquifer which apparently has been reversed due to the pumping to supply brackish water for the salt laydown project and facility needs.

Reclamation: The impacts would be the same as described in the Proposed Action.

4.3.1.3 Alternative C-No Action

Shallow Brine aquifer

Primary Pond Relocation: The impacts would be the same as described in the Proposed Action.

New ditch location on South Leases: These ditches would not be dug and there would be no production accounting for the material coming of the leases due to the fact that the ditch configuration would not change. The salts would still be extracted but it would take a longer time period.

Fringe Acreage Lease: The fringe acreage lease would not be issued and the company would then be in Non-Compliance and other corrective action would have to be taken.

Salt Laydown: The impacts would be the same as described in the Proposed Action except for the fact that there would be no production monitoring approved and a material balance would not be calculated and the company would not be required to continue if they for business reasons decide it is not in their interest to do so.

Reclamation: There would be no reclamation plan approved and a reclamation bond could not be imposed because there is no plan to make the appropriate calculation from. This would not be in accordance with the regulations and there would have to be a new reclamation plan submitted for approval.

Basin Fill aquifer

Primary Pond Relocation: The impacts would be the same as described in the Proposed Action.

New ditch location on South Leases: The impacts would be the same as described in the Proposed Action

Fringe Acreage Lease: The impacts would be the same as described in the Proposed Action

Salt Laydown: The impacts would be the same as described in the Proposed Action

Reclamation: There would be no reclamation plan approved and the Basin Fill aquifer wells would not be reclaimed. This would be a negative impact.

Alluvial Fill aquifer

Primary Pond Relocation: The impacts would be the same as described in the Proposed Action.

New ditch location on South Leases: These ditches would not be dug and there would be no production accounting for the material coming of the leases due to the fact that the ditch configuration would not change.

Fringe Acreage Lease: The fringe acreage lease would not be issued and the company would then be in Non-Compliance and other corrective action would have to be taken.

Salt Laydown: The impacts would be the same as the Proposed Action except for the fact that there would be no production monitoring approved and a material balance would not be calculated.

Reclamation: There would be no reclamation plan approved and a reclamation bond could not be imposed because there is no plan to make the appropriate calculation from. This would not be in accordance with the regulations and there would have to be a new reclamation plan submitted for approval. However, as previously explained, the Salt Laydown Project offers benefits to Intrepid's operation that would result in a probable continuation by the company. If the Salt Laydown Project continues then there would be no effect on the human environment.

4.3.2 Resource 2: ACEC/Cultural Values/Recreation

4.3.2.1 Alternative A-Proposed Action

Primary Pond Relocation: There would be no new impacts to the ACEC and Recreation resources because the primary ponds are not location in these areas.

New Ditch Location on South Leases: There would be no new impacts because the new ditches are not located in the ACEC or Recreation areas.

Fringe Acreage Lease: There would be no new impacts because they are located on the Wendover Bombing Range.

Salt Laydown: In 1997 Reilly Industries (predecessor to Intrepid Potash, Wendover, LLC), began operation of the Salt Laydown Project, which used brackish water from the Alluvial Fan aquifer to flood and re-dissolve bedded halite from Pond 4 North (White, 2002, p. 435-436). White (2002, p. 464; 2004, p. 260) concluded the following from the first five years of the experimental project (1997 – 2002):

1. The Salt Laydown-Project demonstrated that sodium chloride salt in brine removed from the Salt Flats for mineral extraction can be replenished.
2. 6.2 million tons of sodium chloride as human-made enriched brine was pumped back onto the Bonneville Salt Flats from 1 November through at least 30 April for five consecutive years.

3. During the same time period an estimated 4.2 million tons were removed by the production [3]ditches leaving 2 million tons that went directly to the shallow brine aquifer.
4. Geochemical modeling (TEQUIL) showed that within the 28-square-mile Laydown area (Bingham, 1991, p. 435), the shallow brine aquifer has the capacity to accept 17 to 25-million tons of NaCl; this tonnage is about three to four times the 6.2-million tons of salt delivered to the Bonneville Salt Flats during the first five years of the Laydown Project.
5. Consequently, the ability of the shallow-brine aquifer to assimilate additional salt suggests that most of the 6.2 million tons of Laydown-delivered salt resides in the shallow-brine aquifer.
6. The predicted +2 inches of thickness addition to the salt crust (Bingham, 1991, p. 435) as a result of the Laydown Project was not observed at any of the multi-year monitoring locations upon conclusion of the five-year experiment.
7. The addition of Laydown brine to the shallow-brine aquifer neither changes its brine chemistry, nor the existing salt-crust.
8. Based on geochemical modeling (TEQUIL) anhydrite and halite were the only minerals predicted to precipitate from two different simulated mixing ratios of Laydown brine and shallow-aquifer brine in an open system such as Bonneville Salt Flats. This ensures that any small amounts of KCl do not precipitate out of the solution on to the Salt Flats.
9. During the Laydown Project, the removed shallow aquifer brine from mineral production was believed to be mostly replaced by Laydown brine that approached halite saturation and minimized salt-crust dissolution.
10. Consequently the Lay-down brine helped minimize salt-crust dissolution while maintaining the mass balance of total dissolved salts in the shallow-brine aquifer.

By the end of 2005 White and Terrazas (2006, p.3) estimated that over 7 million tons of sodium-chloride salt was delivered to the Bonneville Salt Flats portion of the shallow-brine aquifer during the period 1997 through 2005.

White and Terrazas, 2006 page 26 concluded that "If brine from the shallow brine aquifer is removed from the Salt Flats north of I-80 through the federal-lease-collection ditch, then the total ion mass north of the interstate is decreased by some finite amount that would need to be replaced to maintain the ion mass balance. Consequently, if this withdrawal were to continue for decades without replenishment, one could reasonably conclude that the salt-crust mass north of I-80 could eventually be affected and show some level of impact."

Given the results of White and Terrazas the salt laydown project should have a positive impact on the salt flats.

[3] The 850,000 tons per year production number coming from the collection ditches that was used by White (2006, p.24) was calculated by Mason and Kipp (1998, p.2). They stated "Simulation results indicate a net loss of solute of about 850,000 tons." This simulation result (or output of the model) was based on the input provided by Brooks, 1988. Brooks stated "the amount of salt estimated to have been lost from the salt crust in the 28-year period, 1960-88 is more than 55 million tons. This estimate is based on the change in volume of the salt crust for the 28-year period (S. Brooks, Bureau of Land Management, written commun., 1988) and the average dry density (Mason & Kipp, 1998, p.54)."

Reclamation: There would be positive impacts because the ACEC area would be reclaimed.

4.3.2.2 Alternative B Proposed Action with Mitigation

Primary Pond Relocation: The impacts would be the same as the Proposed Action.

New Ditch Location on South Leases: The impacts would be the same as the Proposed Action

Fringe Acreage Lease: The impacts would be the same as the Proposed Action

Salt Laydown: The effect of the salt laydown project on the resource would be the same as under the proposed action. The only difference is that Intrepid would be obligated to conduct the salt laydown project.

Reclamation: The ditches in the ACEC would be filled in and the ditch berms would be removed. This would bring the surface of the land back to its original contour.

4.3.2.3 Alternative C: No Action

Primary Pond Relocation: There is no recreation in the area of PP5 nor is it in the ACEC, therefor there would be no new impacts.

New ditch location on South Leases: There are no new impacts because there is no recreation in this area and it is not within the ACEC.

Fringe Acreage Lease: There are no new impacts because there is no recreation in this area and it is not within the ACEC.

Salt Laydown: The impacts would be the same as the Proposed Action in that if the salt laydown is accomplished on an intermittent basis, then there could be damage to the mass ion balance in the Shallow Brine aquifer which could impact the salt crust.

Reclamation: There would be no reclamation plan approved and a reclamation bond could not be imposed because there is no plan to make the appropriate calculation. This would not be in accordance with the regulations and there would have to be a new reclamation plan submitted for approval. The ditches on the ACEC may not be reclaimed because there would be no approved reclamation plan.

4.4 Cumulative Impact Analysis

Cumulative impacts are those impacts resulting from the incremental impact of an action when added to other past, present, or reasonably foreseeable actions regardless of what agency or person undertakes such other actions.

4.4.1 Resource 1: Ground Water Hydrology

4.4.1.1 Cumulative Impact Area (CIA)

The CIA for Ground Water Hydrology would be the areas where the aquifers reside.

4.4.1.2 Past and Present Actions

There are no known past or present actions other than the Intrepid operation that would affect the aquifers.

4.4.1.3 Reasonably Foreseeable Actions

The only reasonably foreseeable actions that may affect the aquifers are short or long term climatic conditions.

4.4.1.4 Cumulative Impact Analysis

Drought years may decrease the recharge rate of the aquifers, and wet years increase it. Climatic changes could lead to an increase or decrease of the average level of precipitation, leading to increased or decreased recharge rate.

4.4.2 Resource 2: ACEC/Cultural Values/Recreation

4.4.2.1 Cumulative Impact Area (CIA)

The CIA for these resources is same as for Ground Water Hydrology.

4.4.2.2 Past and Present Actions

Past and present actions such as the, highways and the railroad have affected the BSF. These construction activities have indirectly affected the historic and scenic values and recreation uses of the salt flats.

4.4.2.3 Reasonably Foreseeable Actions

The only reasonably foreseeable actions that may affect the aquifers are short or long term climatic conditions.

4.4.2.4 Cumulative Impact Analysis

Both the railroad and I-80 bisect the BSF, and only the area to the north has been left intact and available for recreation purposes.

Years where there is high precipitation can preclude recreation. The high water year of 1983 precluded most recreational activities on the SRMA for a year.

5.0 CONSULTATION AND COORDINATION

5.1 Introduction

The issue identification section of Chapter 1 identifies those issues analyzed in detail in Chapter 4. The ID Team Checklist provides the rationale for issues that were considered but not analyzed further. The issues were identified through the public and agency involvement process described in sections 5.2 and 5.3 below.

5.2 Persons, Groups, and Agencies Consulted:

Table 5.2.1

Name	Purpose & Authorities for Consultation or Coordination	Findings & Conclusions
Utah State Historic Preservation Office	Consultation for Undertakings as required by the National Historic Preservation Act (16 USC 470).	Project design has excluded these cultural properties from areas to be treated. A finding of "No Historic Properties Effected" under NHPA will be forwarded to the SHPO under the notification clause during the next quarterly Protocol submission.
Paiute, Ute, Western Shoshone, Northwestern Shoshone, Skull Valley Band of Goshutes and Confederated Band of Goshute Reservation	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 USC 1996) and NHPA (16 USC 470).	Notification letters were sent to the Tribes. No responses were received.

5.3 Summary of Public Participation

This project was posted on the ENBB and the SLFO public lobby on 9/30/2005. Since that time, the BLM has received input from the public as well as held meetings with interested parties about the Plan proposal. The EA will be made available for public review and comment before a decision is made.

5.4 List of Preparers

Table 5.4.1 List of Preparers

5.4.1 BLM Name	Title	Responsible for the Following Section(s) of this Document
Larry Garahana	Geologist	Project Lead, geology, administration
Cindy Ledbetter	Environmental Specialist	ACEC, Consultation, NEPA
Peter Ainsworth	Archaeologist	Cultural, Native American
Mike Nelson	AFM, Nonrenewable	Lands
Mike Gates	AFM, Renewable	Wildlife, T&E
Roxanne Tea	Outdoor Recreation Planner	Recreation, OHV, VRM, Wilderness/Character
Erin Darboven	Fire Education & Mitigation Specialist and Public Affairs Officer	Outreach, Fire/Fuels
Heidi Hadley	Hydrologist	Plan Review, hydrology

6.0 REFERENCES, GLOSSARY AND ACRONYMS

6.1 References Cited

Bingham, C.P., 1980, *Solar Pond Production of Potash from the Brines of the Bonneville Salt Flats*: Great Salt Lake a Scientific, Historical and Economic Overview, Utah Geological and Mineral Survey Bulletin 116, pgs. 228-242

Boyles, S., 2010, LIVESTOCK AND WATER, http://beef.osu.edu/library/water.html, Retrieved April 2010

Brooks, S., 1991, Technical Memorandum, COMPARISION OF SALT THICKNESS ON THE BONNEVILLE SALT FLATS, TOOELE COUNTY, UTAH DURING 1960, OCTOBER 1974 AND OCTOBER 1988, Bureau of Land Management, Salt Lake District, 8p.

Content First, 2011, Employment Multipliers, http://www.contentfirst.com/multiplier.shtml, Retrieved, June 2011

EPA, 2010, SECONDARY DRINKING WATER REGULATIONS: Guidance for Nuisance Chemicals,http://www.epa.gov/safewater/consumer/2ndstandards.html, Retrieved March 31, 2010

Ford, M., 1988, MINERAL POTENTIAL REPORT FOR SELECTED LANDS IN THE WENDOVER AREAS AS PART OF THE WESTERN RESOURCES ASSEMBLED LAND EXCHANGE: BLM, Salt Lake Field Office, 11 p.

Intrepid Potash Wendover, 2008, Mine and Reclamation Plan, Intrepid Potash-Wendover LLC Potash Mine, Prepared by Shaw Environmental Inc, Salmon, ID., located that the Utah State Office, Bureau of Land Management, Salt Lake City, Utah

Intrepid Potash Inc, 2011, Investor Presentation, May 2011, http://investors.intrepidpotash.com/phoenix.zhtml?c=218952&p=irol-sec, Retrieved June 27, 2011

Lines, Gregory C., 1979, HYDROGEOLOGY AND SURFACE MORPHOLOGY OF THE BONNEVILLE SALT FLATS AND PILOT VALLEY PLAYA, UTAH: U.S. Geological Survey Water Supply Paper 2057, 105p.

Mason, J.l., Kipp, K.L., 1998, HYDROLOGY OF THE BONNEVILLE SALT FLATS, NORTHWESTERN UTAH, AND SIMULATION OF GROUND-WATER FLOW AND SOLUTE TRANSPORT IN THE SHALLOW-BRINE AQUIFER, U.S. Geological Survey Professional Paper 1585. 108 p.

McMillan, D.T., 1974, Bonneville Salt Flats: A comparison of salt thickness in July, 1960 and October, 1974: Utah Geological and Mineral Survey Report of Investigation No. 91, 6 p.

Nolan, T. B., 1927, Potash brines in the Great Salt Lake Desert, Utah: U.S. Geological Survey Bulletin 795-B, p. 25-44.

Northstar Economics, 2011, The Economic Impact of the Gogebic Taconite Mine, http://www.gogebictaconite.com/News/GTAC%20Impact%20FINAL.pdf, Retrieved June, 2011

Potash Mine, 2011, Potash Commodity, infomine, http://www.infomine.com/chartsanddata/chartbuilder.aspx?z=f&g=127651&dr=3y, Retrieved June 27,2011

Save the Salt webpage http://www.saltflats.com/save%20the%20salt.html 5/19/2011

Turk, L.J., 1969, HYDROGEOLOGY OF THE BONNEVILLE SALT FLATS, Utah: Ph. D. dissertation, Stanford University, 307 p.

United States Bureau of Mines (USBM), 1968, A Dictionary, of Mining, Mineral, and Related Terms, U.S. Department of the Interior, 1269 pages

USDI-BLM 1985 Recreation Area Management Plan (RAMP) for the Bonneville Salt Flats.

USDI Bureau of Land Management. 1990. Pony Express Resource Management Plan and Record of Decision. Salt Lake District Office. Salt Lake City, Utah. January 1990.

United States Security and Exchange Commission (USEC), 2010, Intrepid Potash 10K, Retrieved June 2011 at, http://quote.morningstar.com/stock-filing/Annual-Report/2010/12/31/t.aspx?t=XNYS:IPI&ft=10-K&d=2c7e70f21658f3886f424ba0d74bb24f

White, W. W. III, 2002, Salt Laydown Project – Replenishment of salt to the Bonneville Salt Flats: *In* Gwynn, J.W. editor, Great Salt Lake - An Overview of Change, Special Publication of the Utah Department of Natural Resources 2002, p. 433-486.

White, W. W. III, 2004, Replenishment of salt to the Bonneville Salt Flats: Results of the five-year experimental Salt Laydown Project: *In* Castor, S.B., Papke, K.G., and Meeuwig, R.O., editors., Betting on Industrial Minerals, Proceedings of the 39th Forum on the Geology of Industrial Minerals, Reno/Sparks, Nevada, Nevada Bureau of Mines and Geology Special Publication 33, University of Nevada, Reno. p. 243-262.

White, W.W. III, Terrazas, M., 2006, Analysis of recent and historical salt-crust thickness measurements and assessment of their relationship to the salt laydown project, Bonneville Salt Flats, Tooele County, Utah, Utah Geological Survey, Geology of Northwestern Utah, 31 p.

White, W.W., 2011, Personal Communication Number not available. Discussion on Jun. 23, 2011 concerning the salt inflow to the Bonneville Basin.

Whitney, J. Gordon, *Environmental Impact Analysis Kaiser Aluminum & Chemical Corporation Proposed Pond system V*, 1975

Appendix A- Interdisciplinary Team Analysis Checklist

SCHULLER

INTERDISCIPLINARY TEAM ANALYSIS RECORD CHECKLIST

Project Title: Intrepid Potash Mine and Reclamation Plan **NEPA Log Number:** UT-020-2006-002

File/Serial Number: UTU-087809 through UTU-087818 **Project Leader:** Larry Garahana

DETERMINATION OF STAFF:

Det ermination	Resource	Rationale for Determination	Signature	Date
		CRITICAL ELEMENTS		
NI	Air Quality	PROJECT IS IN AN ATTAINMENT AREA. THE PROJECT WILL NOT CONFLICT W/ UTAHS DAQ SIP #'S AND WILL NOT BE EXCEEDED. ANY P.M. WILL DISPERSE QUICKLY.	Eugene Chamberlain	7/10/06
PI	Areas of Critical Environmental Concern	Mining plan may impact salt conditions in Bonneville Salt Flats SRMA.		7/10/06
NI	Cultural Resources	Cultural resources may be present but the project will does not have the potential to effect cultural resources	Peter Ainsworth	7/19/06
NI	Environmental Justice	Health or Environmental statutes would not be compromised.	Janice Schuller	7/10/06
NP	Farmlands (Prime or Unique)	The proposed Action is not located within units designated as Farmland or farmable.		7/10/06
NI	Floodplains	The Proposed Action may be located within soil units designated as Floodplain. The Proposed Action would not restrict access to insurance		7/10/06
NI	Invasive, Non-native Species	Salt Flat area and flats support little vegetation		7/10/06
NI	Native American Religious Concerns	Consultation with Native American tribes has been completed	Peter Ainsworth	7/17/06
NP	Threatened, Endangered or Candidate Plant Species	Little Vegetation in this area & NO TES species	Rodd Hardy	7/10/06
NP	Threatened, Endangered or Candidate Animal Species			7/
NP	Wastes (hazardous or solid)	No hazardous materials present.	Tim Dwyer	7/17/06
PI	Water ~~Quality~~ Resources (drinking/ground)	may impact existing ground water conditions through several different mechanisms.	Heidi Hadley	4/2011

NP = not present in the area impacted by the proposed or alternative actions
NI = present, but not affected to a degree that detailed analysis is required
PI = present with potential for significant impact analyzed in detail in the EA; or identified in a DNA as requiring further analysis
NC = (DNAs only) actions and impacts not changed from those disclosed in the existing NEPA documents cited in Section C of the DNA form.

Det ermination	Resource	Rationale for Determination	Signature	Date
NP	Wetlands/Riparian Zones	The proposed Action is located on Salt Flats which are lands without potential for Riparian habitat		7/10/06
NP	Wild and Scenic Rivers	Not present.		7/10/06
NP	Wilderness	Not present.		7/10/06
		OTHER RESOURCES / CONCERNS		
NI	Rangeland Health Standards and Guidelines	The proposed Action ~~does~~ would be on an isolated location and would not have impacts for Rangeland health on the landscape		7/10/06
NP	Livestock Grazing	Proposed Action is located outside a grazing allotment.		7/10/06
NP	Woodland / Forestry	There are no trees to speak of in this area		7/10/06
NP	Vegetation including Special Status Plant Species other than FWS candidate or listed species	there is little Vegetation in this Area so impacts is Minimal	Rodd V. Hardy	7/14/06
NP	Fish and Wildlife Including Special Status Species other than FWS candidate/listed	No fish present. Minimal habitat value to any wildlife		7/17/06
NI	Soils	Although soil movement would take place from proposed Action, it is not anticipated that erosion would result from proposed Action.		7/10/06
PI	Recreation	Salt conditions @ BSF are critical to special Recreation Permit events held each year.		7/10/06
NI	Visual Resources	Proposed action would not increase impacts to visual resources already present due to previous activities.		7/10/06
NI	Geology / Mineral Resources/Energy Production	Minimal Reserves are the reason the proposed action is being taken, although detailed analysis is not required.		7/19/06
NP	Paleontology	No known significant paleo resources in project area.		7/19/06
NI	Lands / Access	Proposed action will not receive new lands authorizations		7/17/06

NP = not present in the area impacted by the proposed or alternative actions
NI = present, but not affected to a degree that detailed analysis is required
PI = present with potential for significant impact analyzed in detail in the EA; or identified in a DNA as requiring further analysis
NC = (DNAs only) actions and impacts not changed from those disclosed in the existing NEPA documents cited in Section C of the DNA form.

Det ermi-nation	Resource	Rationale for Determination	Signature	Date
NI	Fuels / Fire Management	~~Fire Plan needed~~ Low fire hazard area. Follow standard fire prevention stips in any location where vegetation exists.		7-24-06
NI	Socio-Economics	Land use plan ~~additions~~ would not change.	Angela Sellers	7/10/06
NP	Wild Horses and Burros	There are no wild Horses present in the area		7/19/06
NP	Wilderness Characteristics	Not identified for project area.		7/10/06

FINAL REVIEW:

Reviewer Title	Signature	Date	Comments
Environmental Coordinator			
Authorized Officer			

NP = not present in the area impacted by the proposed or alternative actions
NI = present, but not affected to a degree that detailed analysis is required
PI = present with potential for significant impact analyzed in detail in the EA; or identified in a DNA as requiring further analysis
NC = (DNAs only) actions and impacts not changed from those disclosed in the existing NEPA documents cited in Section C of the DNA form.

Appendix B
Bonneville Salt Flats Aquifers

Shallow -Brine (Upper) Aquifer Properties:

The Shallow- Brine Aquifer that discharges to the Bonneville Salt Flats and surrounding playa has an aerial extent of at least 975 square miles (White and Terrazas, 2006, p.12). The interbedded sediments in this aquifer assist in the horizontal transport of brines within the aquifer. Specifically, vertical fractures in the lake-sediment clays, gypsum-crystal and oolitic-sand strata provide permeable pathways for lateral and some vertical transport of the brine (Jones and others, 2009; Mason and Kipp, 1998; Turk 1969, p. iii). The transmissivity or amount of flow through an area of the aquifer ranges from 100 feet squared per day (ft2/day) or [13.4 gal per day per ft (gpd/ft)][4] to 13,000 ft2/day [1738 gpd/ft] near the center of the salt crust (Turk, 1973, p.9). Lines reported water flow ranging from 490 ft2/day [65 gpd/ft] - 8100 ft2/day [1082 gpd/ft](Lines, 1979, p.67).[5]

The clay sediments in the shallow brine aquifer are vertically fractured having a maximum width of about 1 inch and a maximum depth of about 25 feet (Lines, 1979, p. 65). These fractures are an additional path for brines to flow horizontally in the clay sediments. Water flow through the fractures ranged from 30 to 140 ft2/day, [4 gpd/ft-18 gpd/ft] (Mason and Kipp, 1998, p.23). These fractures are evident along the sides of the production ditches at the Intrepid mining operation. Through scientific tests this aquifer has the properties of being full to partially full of brine (Turk, 1969, p. 115). Mason states that the confining properties are more prevalent where there is salt crust and more fractures.(Mason and Kipp, 1998, p. 24)

Shallow-Brine (Upper) Aquifer Chemistry:
Intrepid's Wendover operation is currently mining products of sodium chloride (NaCl), potassium chloride (KCl), silvinite ($NaKCl_2$) and magnesium chloride ($Mg\ Cl_2$). The chemical elements that make up these mineral compounds are contained in the brine as ions that reside in the shallow brine aquifer. For example, when the mineral halite (sodium chloride compound which is commonly called table salt), dissolves in water the mineral compound disassociates to form sodium ions or (Na^+) and chloride ions (Cl^-). When the water of the brine evaporates, the mineral compound (i.e. sodium chloride) forms as it precipitates based on a number of factors, mainly concentration and

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[4] **Transmissibility**—The transmissibility of a rock is its capacity to transmit water under pressure. The coefficient of transmissibility is the field coefficient of permeability multiplied by the saturated thickness, in feet, of the aquifer; replaced by the term "transmissivity." To convert a value of transmissivity to a value for coefficient of transmissibility, multiply by 7.48", (McNellis, 1973).

[5] (Note the flow in Ft^2/ft is derived from Ft^3/day per ft of aquifer. By combining terms this equals Ft^2/day).

temperature. Brines from the shallow-brine aquifer result primarily as remnants from multiple evaporation episodes of Lake Bonneville. Major sources for ions comprising the solid and liquid phases of the salt crust and shallow-brine aquifer have been identified as 1) leaching of magnesium, potassium, and sodium from brines entrained in clay-bearing Lake Bonneville sediments, 2) dissolution of geologically older halite and gypsum (evaporate) deposits in the Lake Bonneville basin, and 3) weathering of chloride, bicarbonate, and sulfide-bearing rocks within the Lake Bonneville drainage basin (White and Terrazas, 2006, p.22). Lines (1979, p. 72) states that concentration or density of the brine (weight per unit volume) generally increases from the edges of the playa toward the salt crust. The brine rate of flow increases in this same direction. Table 3.1 lists the chemical composition that makes up the Shallow Brine Aquifer.

Table 3.1 Shallow-Brine Aquifer Typical Chemical Composition (from Intrepid, 2008, Table 3.3).

Analyte Ions	Concentration Range, mg/L	Average, mg/L
Calcium (Ca^{++})	970-2,700	1,558
Magnesium (Mg^{++})	61-5,900	3,816
Potassium (K^{+})	170 – 10,000	6,733
Sodium (Na^{+})l	61,000-130,000	92,862
Bicarbonate (HCO_3^{-1})	73-750	195
Chloride (Cl^{-1})	78,000-210,000	151,655
Sulfate ($SO_4^{-2)}$	2,400-6,800	5,514
Total dissolved solids (TDS)	140,000 – 340,000	279,793

Shallow-Brine (Upper) Aquifer Recharge and discharge:
There are a number of ways that the shallow brine aquifer may be recharged:
Direct meteoric precipitation on the salt and mud flat area. Lines (1979, p.84) stated that the recharge during his study was from direct precipitation.
Horizontal subsurface inflow. Mason and Kipp (1998 p. 30) state horizontal subsurface inflow contributes very little to the shallow brine aquifer. They continue that other possible recharge sources are subsurface inflows from the alluvial fan aquifer and surface runoff from the Silver Island Mountains. Based on gradient information, they determined that these are minor contributors.

Basin Fill aquifer. There was insufficient data to conclude whether or not there was upward leakage of the Deep Brine Aquifer. Mason and Kipp (1998, p. 44) state that the thick sequence and low permeability of the lacustrine sediment in the upper part of the basin-fill (Deep Brine) aquifer probably prohibits leakage from the Upper (Shallow) Brine aquifer even though the driving force is downward.
There are 2 ways which there is discharge from the Shallow-Brine Aquifer.
Direct evaporation at the playa surface (Mason and Kipp, 1998, p.1)
The production (or brine collection) ditches are located in the Shallow-Brine Aquifer. Intrepid Wendover pumps approximately 5 billion gallons of brine from the Shallow-Brine Aquifer annually (Intrepid, 2008, p. 72) throughout the entire 87,000+ acres

controlled by the mining operation. The Utah Division of Water Rights has appropriated the use of over 26 billion gallons per year (Intrepid, 2008, p. 72). There is an increase in dissolved-solids concentration toward the center of the playas and this reflects the natural direction of brine movement toward the natural discharge areas which are the salt crusts. Due to placement of the brine collection ditches in the shallow brine aquifer and the pumping of the alluvial fan aquifer by Intrepid Wendover, the natural direction of the flow of the brines in the aquifers have been reversed (Lines, 1979, p. 90-91). Lines (1979, p. 91) reported that by extracting brines from the carbonate muds, the percentages of potassium and magnesium have decreased in some areas while the concentrations of sodium and chloride have been maintained by re-solution of the salt crust.

Basin-Fill Aquifer Properties:

The Basin-Fill aquifer consists mainly of conglomerate that overlies volcanic rocks that are about 65 million years old (Lines, 1979, p. 57). From 48 to 63 feet deep the aquifer has no fractures or highly permable layers (Mason and Kipp, 1989, p 43). The water flow through this aquifer is reported to be from 2000 ft2/day [267 (gpd/ft)] – 8,000 ft^2/day [1069 gpd/ft](Mason and Kipp, 1998, p.43). Scientific measurements that have been taken show that this is a confined aquifer. (A confined aquifer is bounded by layers that retard the movement of water in and out of the aquifer. An unconfined aquifer is bounded by layers that are pervious). These numbers are significantly lower than those of the Shallow Brine aquifer.

Basin-Fill Aquifer Chemistry:

The following is a list of the ions that occur in the Basin-Fill aquifer. Each ion, with its electronic charge, is shown along with the concentration range, and the unit of measurement.

Table 3.2 Basin-Fill (Deep Brine) Aquifer Chemistry (from Turk, 1969, p.97)

Analyte	Concentration Range, mg/L	Average, mg/L
Calcium (Ca^{++})	1,500-1,600	1,550
Magnesium (Mg^{++})	1,400	1,400
Potassium (K^{+})	1,800-2,000	1,900
Sodium (Na^{+})	41,400-46,000	43,700
Bicarbonate (HCO_3^{-1})	Not Analyzed	Not Analyzed
Chloride (Cl^{-1})	70,000-72,000	71,000
Sulfate (SO_4^{-2})	6,000-6,200	6,100
Total dissolved solids (TDS)	Not Analyzed	Not Analyzed

Basin-Fill Aquifer Recharge and Discharge:

Mason and Kipp (1998, p. 44) stated that the recharge to the aquifer was most likely from the alluvial fan aquifers. Turk (1969, p. 95) suggests that aquifer may be fed by a fault which borders the salt flats on the west side.

The movement and discharge mechanism of the Basin-Fill aquifer is based on studies conducted by Mason and Kipp (1989, p. 44), they synopsized that the ground water flow in this aquifer was from the North to the South and calculations showed the driving force for the groundwater was down even though the Salt Flats is a discharge point for the Great Salt Lake desert and there should be upward movement. This discharge mechanism appears to be inconclusive. Intrepid Wendover also pumps out of this aquifer which provides another mechanism for discharge.

Alluvial Fan Aquifer Properties:

There are several places where the alluvial fan aquifer exists along the East Flank of the Silver Island Mountains. It was created by material deposited by stream flows exiting the canyon that occur along the mountain front. Alluvial fans are mainly composed of poorly sorted pebbles, conglomerates, sand and silts that underlie (Turk, 1969, p.43) and are interbedded with the lake sediments of the Bonneville Salt Flats (Lines, 1979, p.55). Turk (1969, p. 43) stated that the alluvial fans originated prior to Lake Bonneville.

The amount of water that flows through the alluvial fan aquifer per unit area ranges from 185,000 - 475,000 gpd/ft indicating a leaky aquifer (Turk, 1969, p.70, 72)) based on long term pumping tests. A leaky aquifer has the characteristics of a confined aquifer but the layers are semi-pervious and some water can penetrate the layers.

At the present time Intrepid Wendover has 7 wells that can produce approximately 6500 gallons per minute (3.5 billion gallons per year) of make-up-water (Intrepid, 2008, p. 33) for use in their process, but the annual usage is around 1.2 billion gallons per year (Intrepid, 2008, p.72). The Utah Division of Water Rights has placed an appropriation limit of 8.6 billion gallons of make-up-water per year. (Intrepid, 2008, p.72). There has been an increased demand on the alluvial fan aquifer due to the Salt Laydown project. Data taken from the Salt Laydown flow meter in 2005, 2006 and 2009 (located on the discharge side of the system) indicates that there was an average of 255 million gallons pumped out on to the Salt Flats. This number represents the output of the pump for the Salt Laydown project and not the amount of brine removed from the alluvial-fill aquifer. Because of ditch loss, the input number would be larger than the output number of 255 million gallons. The 255 million gallons represents an increase of over 21% in the annual pumping amount.

Alluvial Fan Aquifer Chemistry:

The chemistry of the aquifers indicates that the water is not fresh but contains moderately high levels of ions. In this case, the TDS Turk (1969, p. 77) in 5 samples ranged from 6,800 to 8,200 milligrams per liter (mg/L). Gorrell (1958), defined brackish water that has a range from 1000 – 10,000 ppm, NaCl and from 10,000-100,000 parts per million, (ppm TDS) as salty. Milligrams per liter and parts per million are equivalent for water that weighs 1 kilogram per liter, but as the density of the solution increases the difference between ppm and mg/L can change (Brownlow, 1979, p. 134-135).

Table 3.3 Brackish Well Field (alluvial fan aquifer) Groundwater Quality (from Intrepid, 2008, Table 3.8).		
Analyte	Concentration Range, mg/L	Average, mg/L
Calcium (Ca^{++})	130-670	362
Magnesium (Mg^{++})	110-460	262
Potassium (K^{+})	160-650	332
Sodium (Na^{+})	2700-14,000	6800
Bicarbonate (HCO_3^{-1})	130-160	138
Chloride (Cl^{-1})	3400-19,000	6417
Sulfate (SO_4^{-2})	290-1400	717
Total dissolved solids (TDS)	5300 – 41,000	18,433

Alluvial Fan Aquifer Recharge and Discharge:

Recharge to the alluvial fan aquifers comes from the following sources as described by Turk, (1969, p. 73)

1. Rainfall
2. Leakage of brine from the shallow brine aquifer
3. Subsurface fault-line springs along the mountain front

Discharge is only through pumping, loss to the basin fill aquifer or shallow brine aquifer. There are no springs or seeps that emanate from this aquifer.